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[Face Mask Detection]

INEURON

[DETAIL PROJECT REPORT]

[MACHINE LEARNING]

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1. INTRODUCTION

Corona Virus was originated in Wuhan, China at the end of 2019. Since then, it has been spreading like a wild fire in a forest. Millions have been affected and around 4250000 have unfortunately passed away as on 4th August 2021, almost a year since this virus came to existence. People who have this illness can take up to 2 weeks to cure, with the risk of having to suffer additional medical problems caused by it. Children and old people have proved to be at the highest risk to contract the disease, which may even result in death. Hence, it has been made a priority to contain the virus than to cure it. The virus spreads through the air, transmitted by one person to another not only by touch, but also by speaking and coughing. The concern was put forward to WHO (World Health Organization) which suggested that face masks and social distancing is the answer to it, until a cure is invented. Putting a face mask on can reduce the risk of getting infected by a great extent, not only to the one wearing it but also to the others that he comes in contact with. Wearing masks every time we go out is something we can do with little effort that can effectively save lives, and that is precisely why it is in so much demand at this point of time.

In this paper, we propose a Face Mask Detection project which consists of 2 phases, namely training and deployment. The first stage detects human faces, while the second phase uses deep learning to firstly, identify the ROI(Region Of Interest) being the person's face and secondly classify the faces detected in the first stage as either 'Mask' or 'No Mask' faces and draws boundary of colors either green or red, depending on the output. The project takes streaming video as input. The project can give accurate results if set up with a CCTV camera to track people without masks to ensure the safety and wellbeing of others, thus help controlling the spread of the virus.

We have also created a website which allows anyone to either run the code online directly or download the android application through which face mask detection can be started.

2. Background of the study

Object detection.

Object detection is a computer vision technique that allows you to locate and locate objects in an image or video. With such identification and localization, object detection is used to count objects in a scene and to locate and track their exact locations, while all are labeled correctly. The algorithm generates an axis-aligned boundary box showing a list of object categories in the image and the position and level of each instance of each object category.

CNN

CNN plays an important role in computer vision prototype recognition because of its superior spatial capability Extraction capacity and low computational cost. CNN uses decision kernels to interact with the original Image or feature maps to remove high-end features. However, how to properly design a never-ending network neural Architecture is still a fundamental question. The installation network allows you to find out the proposal network. The best combination of kernels. To train very deep neural networks, K. Heet Al and others proposed residual network (Resnet), which can learn identity mapping from the previous layer. The object detector is usually set Mobile networks (mobile net) are mobile or embedded devices whose computing resources are very limited [29]. Proposed. It uses in-depth discernment to capture features and channel wise resolutions according to channel numbers. Therefore the computational cost of mobile net is much lower than networks that use standard resolutions.

Python

The role of machine learning is to recognize patterns in data. A machine learning engineer is responsible for extracting, processing, refining, cleaning, arranging and making sense of data to develop intelligent algorithms. Python is easy to understand. While linear algebra or calculus concepts can be so complex, they take the maximum amount of effort. Python can be implemented quickly, which helps machine learning engineers to validate an idea promptly.

One of the main reasons why Python is the preferred language for machine learning is its access to many libraries. A library is a collection of functions and routines that a programming language can use. Having access to various libraries allows developers to perform complex tasks without the need to rewrite many code lines. Since machine learning heavily relies on mathematical optimization, probability and statistics, Python libraries help data scientists perform various studies easily. Here are some of the libraries you can use with Python:

OpenCV –provides a real-time optimized Computer Vision library .

Keras – for deep learning.

Matplotlib – to create 2D plots, histograms, charts, etc.

Machine learning

Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop conventional algorithms to perform the needed tasks. Machine learning is closely related to computational statistics, which focuses on making predictions using computers. Data mining is a related field of study, focusing on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is also referred to as predictive analytics.

Deep Learning

Deep learning methods aim at learning feature hierarchies with features from higher levels of the hierarchy formed by the composition of lower level features. Automatically learning features at multiple levels of abstraction allow a system to learn complex functions mapping the input to the output directly from data, without depending completely on human-crafted features. Deep learning allows computational models that are composed of multiple processing layers to learn representations of data with multiple levels of abstraction.

MobileNet

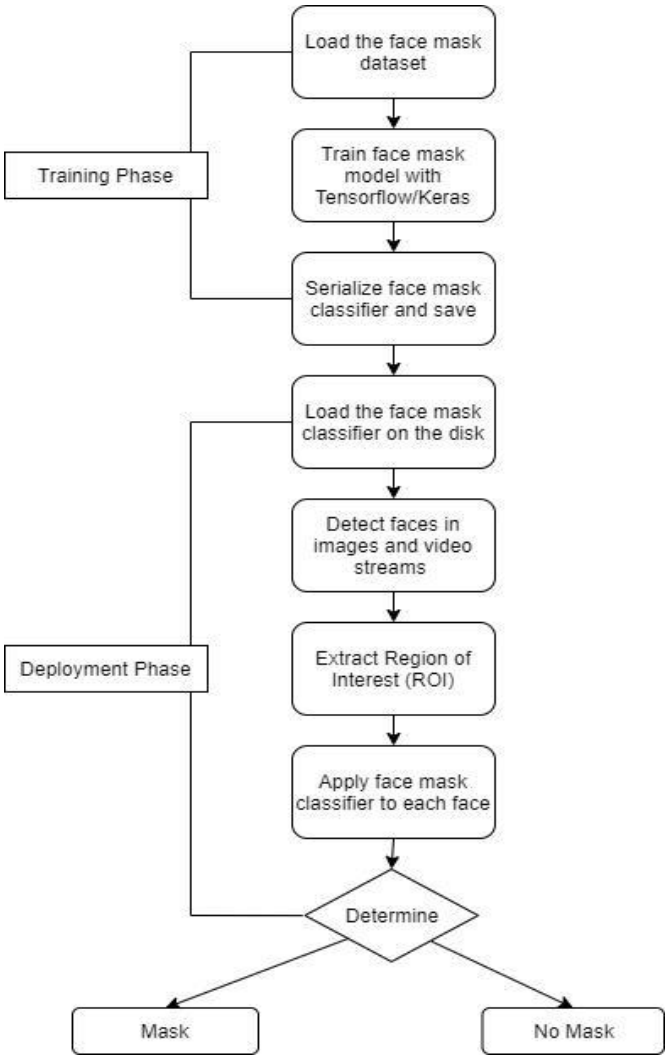
MobileNet is a state of the art for mobile visual recognition including classification, object detection and semantic segmentation. This classifier uses Depth wise Separable Convolution which is introduced to dramatically reduce the complexity cost and model size of the network, and hence is suitable to Mobile devices, or devices that have low computational power. In MobileNet, another best module that is introduced is inverted residual structure. Non-linearity in narrow layers is deleted. Keeping MobileNet as backbone for feature extraction, best performances are achieved for object detection and semantic segmentation.

3. SYSTEM ARCHITECTURE

This system aims at classifying whether a person is wearing a mask or not by taking input from images real time streaming videos. We have taken a total of 3847 images in our Face Mask Detection Dataset belonging to two labels i.e. with mask: 1917 images and without mask: 1930 images. The classification of the images is done by training the model in 2 phases:

Phase 1: Training- Training the model on the dataset using Tensorflow & Keras with classifier like MobileNetV2 is used to generate a trained model.

Phase2: Deployment - Loading the trained model and applying detector over images/live video stream



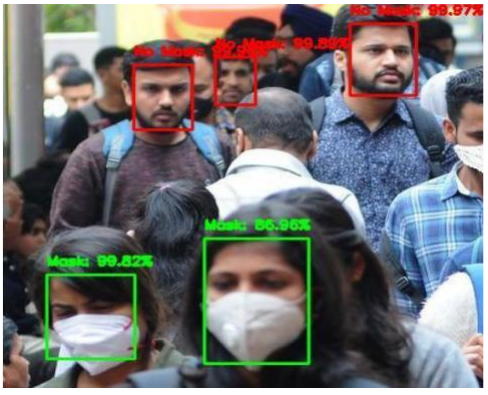
4. Results

We created a face mask detector using Deep Learning, Keras, Tensorflow and OpenCV. We trained it to distinguish between people wearing mask and people not wearing a mask we have used MobileNet classifier with the ADAM optimizer for the best result.

Some images of with mask dataset

Some images of without mask dataset

Test Outputs



Output of Face Mask Detector in Uploaded Image

The accuracy of the model is calculated to be 98%.

It is observed that performance of ADAM optimizer is good in both training and testing.

Accuracy/Loss Plot

5. SUMMARY

As the technology are blooming with emerging trends the availability so we have novel face mask detector which can possibly contribute to public healthcare. The architecture consists of Mobile Net as the backbone it can be used for high and low computation scenarios. In order to extract more robust features, we utilize transfer learning to adopt weights from a similar task face detection, which is trained on a very large dataset. We used OpenCV, Tensorflow, Keras , Pytorch and CNN to detect whether people were wearing face masks or not. The models were tested with images and real-time video streams. The accuracy of the model is achieved and, the optimization of the model is a continuous process and we are building a highly accurate solution by tuning the hyper parameters. This specific model could be used as a use case for edge analytics. Furthermore, the proposed method achieves state-of-the-art results on a public face mask dataset. By the development of face mask detection, we can detect if the person is wearing a face mask and allow their entry would be of great help to the society.